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"Evaluation of Patient Perceptions and Wound Healing After Vestibuloplasty Procedure: A Comparison of Diode Laser and Scalpel Techniques"

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ABSTRACT

Introduction: *A luminous smile indicates health and emotional stability, influenced by gingival health and tooth positioning. Periodontal plastic surgery improves aesthetics and hygiene. Insufficient vestibular depth complicates plaque control, leading to gingival issues. Treatments like vestibuloplasty enhance vestibular depth, with laser techniques gaining popularity for their reduced discomfort and improved outcomes. This study compares diode laser and scalpel effectiveness in treating inadequate vestibular depth.*

Methodology: *The present study is a randomised controlled trial conducted on 20-40 year-old patients, visiting the out-patient department. The patients without any systematic diseases, those with the inadequate vestibular depth and insufficient attached gingiva were recruited. Informed consent was taken, ethical approval was obtained before the start of the study, and the participants were randomly assigned into two groups. Vestibuloplasty was done either by Diode Laser (808 nm wave length) experimental group or by traditional Clark's method, control group. Follow up was taken at 1st, 3rd, 7th, 21st day postop.*

Results: *The healing of the wound, as determined by the Landry Wound Healing Index, was statistically different between the Diode Laser and Scalpel Technique groups. 58.3% of participants in the experimental group had "Good" score, as compared to 50% in the control group on Day 1. At Day 7, 41.7% of the experimental group had "Excellent" scores, as compared to 0% of the control group. (p = 0.011) The patient perception scores taken by VAS scale showed consistently lower perception score for the diode laser group.*

Discussion: *Our results indicated that an initial reduction in pain scores was found with Laser treatment, and patient-reported outcomes were similarly superior for those who received Diode Laser therapy. Laser technique not only facilitates faster wound healing but also enhances patient comfort and perception of pain compared to the traditional Scalpel technique. Further research on different wavelengths of the Diode Laser and their effect on wound healing in varied population groups is the need of the hour.*

Key words: *Diode Laser, Vestibuloplasty, Wound healing*

INTRODUCTION

A luminous smile reflects physical health and emotional stability, influenced by factors like gingival tissues and tooth positioning. [1] Periodontal plastic surgery enhances both aesthetics and oral hygiene maintenance. [2] Effective plaque management is facilitated by a typical vestibule, but anatomical variations, such as elevated muscle attachments, can reduce vestibular depth and keratinised gingiva, crucial for periodontal health. [3] Keratinisation protects the periodontium from friction during mastication and helps resist tension from mucosal connections. Narrow gingiva and shallow vestibular sulcus can lead to food buildup and hinder oral hygiene, increasing the risk of gingival recession. [4,5] The required width of

keratinised and connected gingiva for optimal gingival health is debated among periodontists, with 2 mm and 1 mm considered ideal. Insufficient vestibular depth complicates plaque control and leads to issues like gingival inflammation. In light of the mucogingival issue caused by insufficient vestibular depth, a variety of treatment modalities, including gingival augmentation utilising grafts and vestibuloplasty by secondary epithelialisation, have been devised to improve vestibular depth. [6]

Vestibuloplasty is a mucogingival surgery aimed at modifying the relationship between the gingiva and mucous membrane, primarily to enhance vestibular depth in edentulous areas. [7] Various techniques, such as Edlanplasty and Kazanjian vestibuloplasty have been developed, with Clark's vestibuloplasty gaining popularity for addressing mucogingival issues. [8-11] Traditional methods, however, are often associated with significant pain, prolonged recovery, and high relapse rates, making them less favorable. [12]

In recent years, periodontal procedures have shifted towards less invasive techniques, largely due to advancements in laser technology. Lasers offer numerous advantages over traditional scalpels, including a sterile field, better haemostasis, and reduced postoperative discomfort and swelling. Different laser types, such as Erbium: Yttrium-Aluminum-Garnet (Er: YAG), Neodymium: Yttrium-Aluminum-Garnet (Nd: YAG), and diode lasers, have been incorporated into vestibuloplasty practices. [13,14]

Research supports the effectiveness of various lasers, including CO2 and diode lasers, in improving clinical outcomes in periodontal surgeries. Diode lasers, particularly those operating at 810 nm, are widely used due to their compactness and cost-effectiveness. [15-17] While there is substantial literature on diode lasers in soft tissue procedures like frenectomy and gingivectomy, there is limited evidence regarding their application in vestibuloplasty. This gap in research highlights the need for further studies to explore the efficacy of diode lasers specifically in vestibuloplasty procedures. Thus, this study was conducted to evaluate and compare the patient perceptions and wound healing outcomes in the treatment of inadequate vestibular depth either with the diode laser or the scalpel.

METHODOLOGY

The present study was a Randomized Controlled Trial conducted in 20–40-year-old individuals who were undergoing Orthodontic Therapy and who were diagnosed to have inadequate vestibular depth and insufficient attached gingiva. The study was conducted in order to evaluate and compare the effectiveness of patient perceptions and wound healing outcomes in the treatment of inadequate vestibular depth either with the diode laser or the scalpel. The study was conducted in the Department of Periodontics at Dr. D.Y Patil Dental College, Navi Mumbai. The prime duration of study was 6 months after obtaining the clearance from the University. Ethical clearance was obtained from the Scientific Advisory Committee and Institutional Ethics Committee (xxxx/IEC/OUT/2020-21/21). The examination and recording of the proforma were carried out by a single examiner (investigator himself.) Before commencing the study, the training and calibration of the examiner was done in Department of Periodontology & Oral Implantology, DR. D Y Patil Deemed to be University – School of Dentistry Nerul, Navi Mumbai. The principal investigator was calibrated for Recording the Data Collection Sheet, evaluation of the Wound using Scale prepared by Amorim et al, Scoring Patients Perceptions using VAS Scale.

A pilot study with 10 participants was conducted, and data was recorded. These participants were not included in the main study. Sample size for comparative was calculated using two-sided significance level (1- alpha at 95%, Power using Open Epi, Version 3, open-source calculator, which was 10 participants in each group, with the total of 20 participants each.

Participants visiting the OPD of Department of Periodontics at Department of Periodontology & Oral Implantology, DR. D Y Patil Deemed to be University – School of Dentistry Nerul, Navi Mumbai were evaluated for their oral hygiene, vestibular depth and attached gingiva.

Patients between the ages of 20-40 years, without any systemic disease, with minimum of 20 natural teeth present. Those patients who had inadequate vestibular depth, insufficient attached gingiva in the mandible, and those who were willing to comply for all the requirements of the study were included in the study. The participants with a history of periodontal disease, or ongoing periodontal therapy, with systemic diseases, smokers, pregnant and lactating mothers were excluded from the study. All participants who wished to withdraw from the study were allowed to do so at any point of time. A list of participants was drawn who fulfilled the criteria and the participants were further subjected to randomization using lottery method into experimental group and control group. Group 1 (Diode Laser) and Group (Scalpel). Standard oral hygiene instructions, following the Phase I therapy were given to the patients during the course of the study. For the control group vestibuloplasty was done by Clark's method. Local anaesthesia

was delivered bilaterally via a mental nerve block using 1:80,000 adrenaline, a horizontal incision was made in the mucous membrane at the mucogingival junction using a No. 15 scalpel blade. The incision was elongated through sharp dissection, excising all muscle fibres above the periosteum, and the mucosal flap was sutured at the vestibular depth. For the experimental group, 808 nm wave length diode laser with 400 µm an initiated surgical tip was used with 1 to 1.5W settings in a continuous mode. Ablation with the laser tip was initiated at the mucogingival junction with a horizontal stoke directing the laser parallel to the bone slowly relieving the muscle fibers till the desired depth. Tension was placed by retracting the patient's lip to enable the laser assisted excision of the muscle fibers. The mucosa of lip was sutured at the depth of vestibule. For all patients, along with oral hygiene reinforcement, Chlorhexidine (0.2%) mouth rinse was prescribed twice daily for three weeks postoperatively. The evaluator, participants and statistician were blinded to the type of intervention group. After the intervention with either Diode Laser or Scalpel was done, the analysis of wound healing was done using a scale prepared by Amorim et al. The data was collected on the 1st, 3rd, 7th and on the 21st day, postop. Along with it the patients' perceptions were recorded using Visual Analog Scale (VAS) Scale.

The recorded data was compiledand was checked for normality. The statistical analysis was done using Statistical Package for Social Science (IBM SPSS Statistic for window, version 21 Armonk, NY: IBM Corp.) Descriptive statistics were performed for all the findings and Mean and Standard Deviation (SD) Frequency and Percentage were calculated.

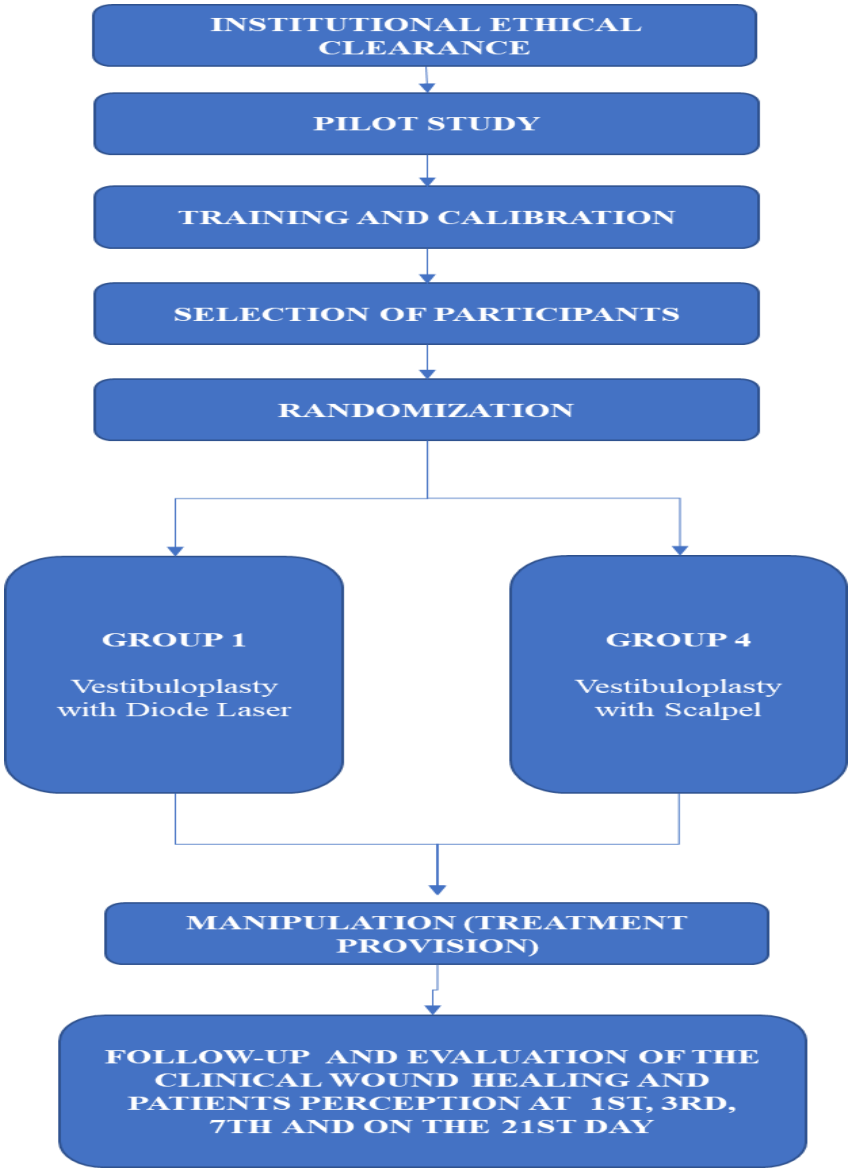

Figure 1: Flowchart of Study Methodology

RESULTS

The sample consisted of 24 subjects, with a near-equal number of males and females in each group. The age range of the participants was comparable, with the Diode Laser group averaging 29.2 years (SD = 6.13) and the Scalpel Technique group averaging 28.3 years (SD = 6.69).

	Groups	N	GENDER		AGE	
			Male	Female	Mean	SD
Age	Diode Laser	12	7	5	29.2	6.13
	Scalpel Technique	12	6	6	28.3	6.69

TABLE 1

The healing of the wound, as determined by the Landry Wound Healing Index, was statistically different between the Diode Laser and Scalpel Technique groups. On day one, most of the Diode Laser-treated subjects had "Good" (58.3%) or "Very Good" (41.7%) healing, while 50% of the Scalpel-treated subjects had "Good" healing, with 50% having "Poor" or "Very Poor" healing (p = 0.011). By day 7, 41.7% of Diode Laser-treated wounds were at the "Excellent" level, whereas none of the Scalpel group were, with 75% remaining "Good" (p = 0.008). By day 21, 75% of Diode Laser-treated wounds were "Excellent," whereas only 16.7% were in the Scalpel group (p = 0.011), indicating that Diode Laser treatment allowed for better healing with time. Within-group comparisons also showed statistically significant healing improvement over time, with the Diode Laser group having faster improvement than the Scalpel Technique group. Tables 2, 3, 4 and 5 illustrate the findings in detail.

TABLE 2: Comparison of the Landry Wound Healing Index Score between Participants Treated with Diode Laser and Scalpel Technique

Landry Wound Healing Index Score		Very Poor		Poor		Good		Very Good		Excellent		Total		p Value
		n	%	N	%	n	%	n	%	n	%	n	%	
1st Day	**Diode Laser**	0	0.0 %	0	0.0 %	7	58.3 %	5	41.7 %	0	0	12	100.0 %	0.011
	Scalpel Technique	2	16.7 %	4	33.3 %	6	50.0 %	0	0.0 %	0	0	12	100.0 %	
3rd Day	**Diode Laser**	0	0.0 %	0	0.0 %	4	33.3 %	8	66.7 %	0	0	12	100.0 %	0.038
	Scalpel Technique	0	0.0 %	1	8.3 %	9	75.0 %	2	16.7 %	0	0	12	100.0 %	
7th Day	**Diode Laser**	0	0.0 %	0	0.0 %	2	16.7 %	5	41.7 %	5	41.7 %	12	100.0 %	0.008
	Scalpel Technique	0	0.0 %	1	8.3 %	9	75.0 %	2	16.7 %	0	0.0 %	12	100.0 %	
21st Day	**Diode Laser**	0	0.0 %	0	0.0 %	0	0.0 %	3	25.0 %	9	75.0 %	12	100.0 %	0.011
	Scalpel Technique	0	0.0 %	0	0.0 %	3	25.0 %	7	58.3 %	2	16.7 %	12	100.0 %	

	χ^2	df	p

Landry Wound Healing Index Score (Diode Laser)	22.6	3	< .001
Landry Wound Healing Index Score (Scalpel Technique)	22.4	3	< .001

TABLE 3

TABLE 4: Within Group Comparison of the Landry Wound Healing Index Score for Participants treated with Diode Laser

Pairwise comparisons - Landry Wound Healing Index Score (Diode Laser)			
		W	**p**
1st Day	3rd Day	1.7	0.625
1st Day	7th Day	3.73	0.042
1st Day	21st Day	5.59	< .001
3rd Day	7th Day	2.89	0.172
3rd Day	21st Day	5.32	< .001
7th Day	21st Day	2.52	0.282

TABLE 5: Within Group Comparison of the Landry Wound Healing Index Score for Participants treated with Scalpel Technique

Pairwise comparisons - Landry Wound Healing Index Score (Scalpel Technique)			
		W	**p**
1st Day	3rd Day	3.5	0.065
1st Day	7th Day	3.5	0.065
1st Day	21st Day	5.37	< .001
3rd Day	7th Day	0	1
3rd Day	21st Day	4.1	0.02
7th Day	21st Day	4.1	0.02

The findings of the study indicate considerable differences in patient perception scores at different periods between the diode laser and scalpel technique groups. On day one, the patient perception score was slightly smaller in the diode laser group (77.33 ± 10.6) than in the scalpel technique group (82.5 ± 10.63), but the difference was not significant ($p = 0.926$). But both groups, in the course of time, exhibited a significant decline in the patient perception scores, showing improvement in patient experience and decreased discomfort. By day three, the mean score had dropped to 46.42 ± 8.36 in the diode laser group and 60.17 ± 10.88 in the scalpel technique group, and there was a statistically significant difference ($p = 0.038$), which indicated that patients who were treated with the diode laser felt less pain than those treated with the scalpel. At the seventh day, scores decreased further with the diode laser group posting a mean score of 24.25 ± 3.84 and the scalpel group posting 34.92 ± 9.9. The difference was still statistically significant ($p = 0.037$), which was further evident of the better patient experience in the diode laser group. By day 21, the average perception scores were almost at baseline levels, the diode laser group having 1.83 ± 2.08 and the scalpel group having 4.75 ± 4. Although statistically insignificant ($p = 0.368$), the trend showed a consistently lower perception score for the diode laser group, reflecting a more positive healing experience. The within-subjects effect was highly significant according to repeated measures analysis ($F = 449.36$, $p < 0.001$), verifying that patient perception scores fell significantly over time. While the interaction effect between time and groups ($F = 2.58$, $p = 0.061$) was not statistically significant, the between-subjects effect ($F = 15.6$, $p < 0.001$) verified a significant difference between the two techniques in general. Pairwise comparison also illustrated that the diode laser group exhibited significantly lower perception scores at all subsequent time points after day 1 compared with the scalpel group. The

differences between consecutive time points in patient perception scores were also extremely significant ($p < 0.001$), with the greatest differences between days 1 and 21.

TABLE 6: Mean Distribution of the Patient Perception Score at 1 day, 3 day, 7 days and 21 Days

	Groups	N	Minimum	Maximum	Median	Mean	SD
Patient Perception Score 1st Day	Diode Laser	12	62	93	75.5	77.33	10.6
	Scalpel Technique	12	62	93	87	82.5	10.63
Patient Perception Score 3rd Day	Diode Laser	12	35	59	45.5	46.42	8.36
	Scalpel Technique	12	40	77	61.5	60.17	10.88
Patient Perception Score 7th Day	Diode Laser	12	20	30	23	24.25	3.84
	Scalpel Technique	12	20	47	35.5	34.92	9.9
Patient Perception Score 21st Day	Diode Laser	12	0	5	1.5	1.83	2.08
	Scalpel Technique	12	0	10	4	4.75	4

TABLE 7: Comparison of the Patient Perception Score at 1 day, 3 day, 7 days and 21 Days between Diode Laser Group and Scalpel Group

Within Subjects Effects					
	Sum of Squares	**df**	**Mean Square**	**F**	**p**
RM Factor 1	77202	3	25734.1	449.36	< .001
RM Factor 1 ✻ Groups	444	3	148	2.58	0.061
Residual	3780	66	57.3		
Note. Type 3 Sums of Squares					

Between Subjects Effects					
	Sum of Squares	**df**	**Mean Square**	**F**	**p**
Groups	1584	1	1584	15.6	< .001
Residual	2236	22	102		
Note. Type 3 Sums of Squares					

RM Factor 1	RM Factor 1	Mean Difference	SE	df	t	p_{tukey}
Patient Perception Score 1st Day	Patient Perception Score 3rd Day	26.6	3.02	22	8.81	< .001
	Patient Perception Score 7th Day	50.3	2.35	22	21.43	< .001
	Patient Perception Score 21st Day	76.6	2.28	22	33.57	< .001

Patient Perception Score 3rd Day	Patient Perception Score 7th Day	23.7	1.81	22	13.09	< .001
	Patient Perception Score 21st Day	50	1.97	22	25.36	< .001
Patient Perception Score 7th Day	Patient Perception Score 21st Day	26.3	1.27	22	20.69	< .001

TABLE 8: Pairwise Comparison of the Patient Perception Score at 1 day, 3 day, 7 days and 21 Days between Diode Laser Group and Scalpel Group

RM Factor 1	Groups	RM Factor 1	Groups	Mean Difference	SE	p_{tukey}
Patient Perception Score 1st Day	Diode Laser	Patient Perception Score 1st Day	Scalpel	-5.17	4.33	0.926
		Patient Perception Score 3rd Day	Diode Laser	30.92	4.27	< .001
		Patient Perception Score 3rd Day	Scalpel	17.17	4.15	0.009
		Patient Perception Score 7th Day	Diode Laser	53.08	3.32	< .001
		Patient Perception Score 7th Day	Scalpel	42.42	3.75	< .001
		Patient Perception Score 21st Day	Diode Laser	75.5	3.23	< .001
		Patient Perception Score 21st Day	Scalpel	72.58	3.2	< .001
	Scalpel Technique	Patient Perception Score 3rd Day	Diode Laser	36.08	4.15	< .001
		Patient Perception Score 3rd Day	Scalpel	22.33	4.27	< .001
		Patient Perception Score 7th Day	Diode Laser	58.25	3.75	< .001
		Patient Perception Score 7th Day	Scalpel	47.58	3.32	< .001
		Patient Perception Score 21st Day	Diode Laser	80.67	3.2	< .001
		Patient Perception Score 21st Day	Scalpel	77.75	3.23	< .001
Patient Perception Score 3rd Day	Diode Laser	Patient Perception Score 3rd Day	Scalpel	-13.75	3.96	0.038
		Patient Perception Score 7th Day	Diode Laser	22.17	2.56	< .001
		Patient Perception Score 7th Day	Scalpel	11.5	3.54	0.061
		Patient Perception Score 21st Day	Diode Laser	44.58	2.79	< .001
		Patient Perception Score 21st Day	Scalpel	41.67	2.95	< .001
	Scalpel Technique	Patient Perception Score 7th Day	Diode Laser	35.92	3.54	< .001
		Patient Perception Score 7th Day	Scalpel	25.25	2.56	< .001
		Patient Perception Score 21st Day	Diode Laser	58.33	2.95	< .001
		Patient Perception Score 21st Day	Scalpel	55.42	2.79	< .001
Patient Perception Score 7th Day	Diode Laser	Patient Perception Score 7th Day	Scalpel	-10.67	3.07	0.037
		Patient Perception Score 21st Day	Diode Laser	22.42	1.8	< .001
		Patient Perception Score 21st Day	Scalpel	19.5	2.36	< .001
	Scalpel Technique	Patient Perception Score 21st Day	Diode Laser	33.08	2.36	< .001
		Patient Perception Score 21st Day	Scalpel	30.17	1.8	< .001
Patient Perception Score 21st Day	Diode Laser	Patient Perception Score 21st Day	Scalpel	-2.92	1.3	0.368

On the first day, both groups indicated 100% severe pain. By the 7th and 3rd days, all Diode Laser group participants had just "Moderate" pain, while the Scalpel group still had 58.3% of participants experiencing "Severe" pain (p = 0.002). By day 21, the majority of patients in both groups had only "Mild" or "No Pain," but the Diode Laser group had a marginally higher rate of patients with no pain (41.7%) than the Scalpel group (25%).

TABLE 9: Comparison of the Patient Perception Grade between Diode Laser and Scalpel Technique at 1st, 3rd, 7th and 21st Day.

			Patient Perception Grade				Total	p Value
			No Pain	Mild	Moderate	Severe		
1st Day	Diode Laser	n	0	0	0	12	12	1.00
		%	0%	0%	0%	100.0 %	100.0 %	
	Scalpel Technique	n	0	0	0	12	12	
		%	0%	0%	0%	100.0 %	100.0 %	
3rd Day	Diode Laser	n	0	0	12	0	12	0.002
		%	0%	0%	100.0 %	0%	100.0 %	
	Scalpel Technique	n	0	0	5	7	12	
		%	0%	0%	41.7 %	58.3 %	100.0 %	
7th Day	Diode Laser	n	0	0	12	0	12	0.002
		%	0%	0%	100.0 %	0%	100.0 %	
	Scalpel Technique	n	0	0	5	7	12	
		%	0%	0%	41.7 %	58.3 %	100.0 %	
21st Day	Diode Laser	n	5	7	0	0	12	0.386
		%	41.7 %	58.3 %	0%	0%	100.0 %	
	Scalpel Technique	n	3	9	0	0	12	
		%	25.0 %	75.0 %	0%	0%	100.0 %	

TABLE 10: Within Comparison of the Patient Perception Grade between Diode Laser at 1st, 3rd, 7th and 21st Day.

Pairwise Comparisons (Durbin-Conover)

				Statistic	p
Patient Perception Grade Diode Laser 21st Day	-	Patient Perception Grade Diode Laser 7th Day		4.86	< .001
Patient Perception Grade Diode Laser 21st Day	-	Patient Perception Grade Diode Laser 3rd Day		19.91	< .001
Patient Perception Grade Diode Laser 21st Day	-	Patient Perception Grade Diode Laser 1st Day		31.56	< .001
Patient Perception Grade Diode Laser 7th Day	-	Patient Perception Grade Diode Laser 3rd Day		15.05	< .001
Patient Perception Grade Diode Laser 7th Day	-	Patient Perception Grade Diode Laser 1st Day		26.70	< .001
Patient Perception Grade Diode Laser 3rd Day	-	Patient Perception Grade Diode Laser 1st Day		11.65	< .001

TABLE 11: Within Comparison of the Patient Perception Grade between Scalpel Technique at 1st, 3rd, 7th and 21st Day.

Pairwise Comparisons (Durbin-Conover)

			Statistic	p
Patient Perception Grade Scalpel Technique 1st Day	-	Patient Perception Grade Scalpel Technique 3rd Day	3.58	0.001
Patient Perception Grade Scalpel Technique 1st Day	-	Patient Perception Grade Scalpel Technique 7th Day	11.00	< .001
Patient Perception Grade Scalpel Technique 1st Day	-	Patient Perception Grade Scalpel Technique 21st Day	17.33	< .001
Patient Perception Grade Scalpel Technique 3rd Day	-	Patient Perception Grade Scalpel Technique 7th Day	7.43	< .001
Patient Perception Grade Scalpel Technique 3rd Day	-	Patient Perception Grade Scalpel Technique 21st Day	13.76	< .001
Patient Perception Grade Scalpel Technique 7th Day	-	Patient Perception Grade Scalpel Technique 21st Day	6.33	< .001

On the basis of the Amorim et al Wound Healing Index, an increased percentage of Diode Laser-treated wounds presented with greater healing at all stages. On the 1st day, 66.7% of wounds treated with the Diode Laser showed greater healing. On the 21st day, 83.3% of Diode Laser-treated wounds had a greater degree of healing as opposed to 16.7% under "same degree of healing" (p = 0.763). This trend indicates that the Diode Laser technique facilitated more rapid and effective healing of wounds.

TABLE 12: Distribution of the Amorim et al Wound Healing Index Score at 1st, 3rd, 7th and 21st Day.

Time Interval		Amorim et al Wound Healing Index Score			p Value
		the same degree of healing response	Indicating Superior Healing of Laser-treated wounds	Total	
1st Day	N	4	8	12	0.763
	%	33.3 %	66.7 %	100.0 %	
3rd Day	N	4	8	12	
	%	33.3 %	66.7 %	100.0 %	
7th Day	N	3	9	12	
	%	25.0 %	75.0 %	100.0 %	
21st Day	N	2	10	12	
	%	16.7 %	83.3 %	100.0 %	
Total	N	13	35	48	
	%	27.1 %	72.9 %	100.0 %	

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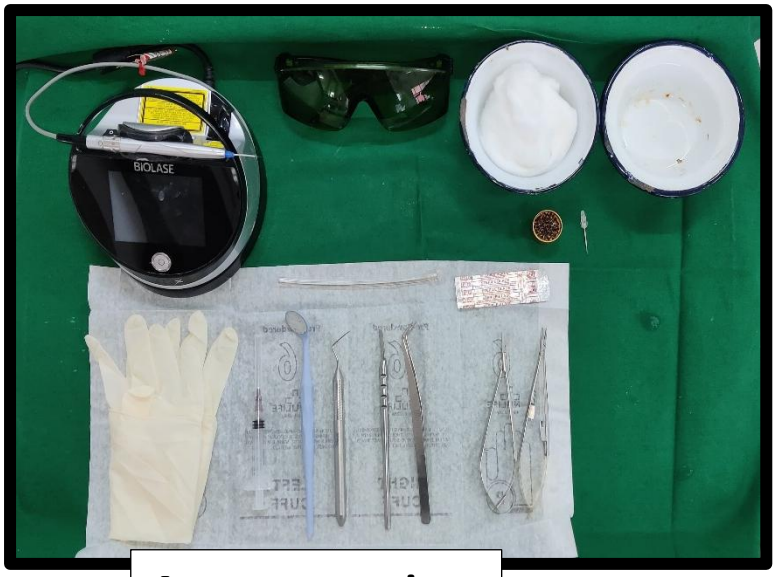
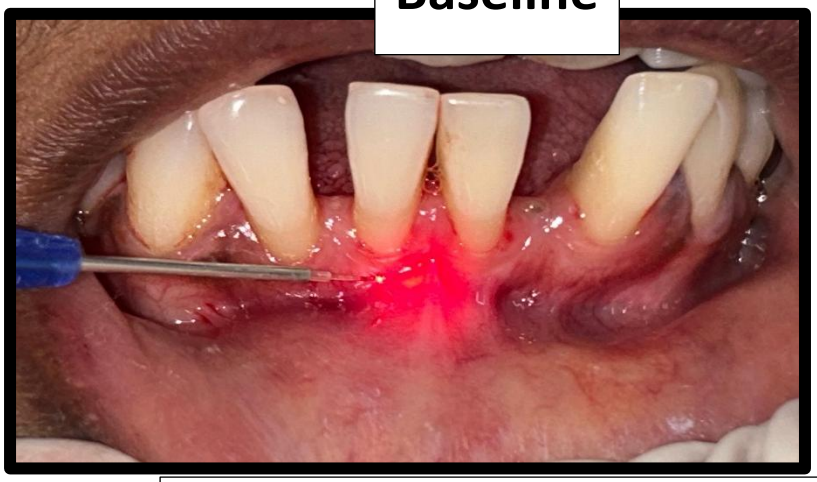


Armamentarium

Baseline



Intraoperative view during the procedure

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Incision with laser to relieve the muscle fibers

Periosteal sutures given

3rd Day Follow up

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7th Day Follow up

21st Day Follow up

Clark's Vestibuloplasty with scalpel

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Incision with scalpel to relieve the muscle fibers

Periosteal Sutures given

3rd Day Follow up

7th Day Follow up

21st Day Follow up

DISCUSSION

Our results indicated that an initial reduction in pain scores was found with Laser treatment, and patient-reported outcomes were similarly superior for those who received Diode Laser therapy. Our findings align with the research of Kalakonda B et al [18], which indicates that lasers may be utilised in place of the conventional vestibuloplasty surgery. Low-level treatment was applied to the wound bed following the surgical operation. Low-level laser therapy enhances the creation of the body's endogenous analgesics, β-endorphins, and diminishes the activity of C fibres, hence facilitating pain alleviation. [18,19] This was apparent in the reduced VAS values for pain and discomfort in the laser group relative to the scalpel group. Our findings align with those of Demir et al. and Neckel et al., who demonstrated superior wound healing following a laser-assisted vestibuloplasty compared to the scalpel group. [20,21]

Our results reportedly found a similarity with VAS Scores among gender and age it was observed that due to similarity in Gender and Age of the participants recruited we initially minimized the selection and allocation bias of the study. We found that our results hence showed similarity with Kelly et al [22] who reported that VAS scores for pain were influenced by either age or gender.

Our study did not depict any similarity with the literature published by Nath et al [23] who reported that wound healing in laser showed delay in healing and this may be due to formation of protein coagulam on wound surface. The key strengths of our study were application of randomization. Minimizing the selection bias and recruitment bias.

The key limitations of the study were that to generalize our findings to greater extent we need to conduct the study at multiple setting. The time duration considered for the follow up needed to be greater. The long-term results might vary. Considering the limitations of the study we further plan to prospectively study a large population keeping a multicentric approach and increasing the follow-up. Also utilizing different wavelengths which might potentially affect the healing of the Gingiva.

CONCLUSION

In terms of the Wound Healing Outcomes, we observed a statistically significant differences in wound healing were observed between the two groups, with the Diode Laser group showing superior healing on days 1, 7, and 21. By day 21, 75% of wounds in the Diode Laser group were rated as "Excellent," compared to only 16.7% in the Scalpel group.

The Within-Group Healing Improvement supported the literature suggesting that the Diode Laser group demonstrated faster and more significant healing improvements over time compared to the Scalpel Technique group.

In terms of the Patient Perception Scores it was observed that initial scores showed no significant difference, but by day 3, the Diode Laser group reported significantly lower pain levels than the Scalpel group. This trend continued through day 21, indicating a better patient experience with the Diode Laser technique.

On Pain Assessments it was observed that on day 1, all participants reported severe pain, but by day 7, the Diode Laser group had transitioned to moderate pain, while the Scalpel group still had a significant

percentage experiencing severe pain. By day 21, the Diode Laser group had a higher percentage of patients reporting no pain compared to the Scalpel group.

Amorim et al Wound Healing Index depicted that the Diode Laser technique consistently showed a greater percentage of wounds with improved healing at all stages, reinforcing its effectiveness over the Scalpel technique.

Considering all the above cumulative points we conclude that the Diode Laser technique not only facilitates faster wound healing but also enhances patient comfort and perception of pain compared to the traditional Scalpel techniques.

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